TURBIDITY MONITORING RESULTS
LINCOLN PARK BEACH RE-NOURISHMENT PROJECT

1. The 2002 Lincoln Park Beach Re-Nourishment Replacement construction occurred on October 17, 18, 21, 22, 23, and 24, 2002. The purpose of the project was to replace material eroded from the beach since the last re-nourishment event in 1994. Washed sand and gravel was delivered from the DuPont pit of Glacier Northwest to the beach at low tide via a conveyor from a barge. Equipment was delivered to the work area by another barge. The barges were held in position by several spuds. The stockpiled material was spread with a backhoe holding a spreader bar (see Figure 1). All work was done in the dry and no in-water work occurred. However, high tide covered at least some portion of the new material twice a day. For the project, 1,500 cubic yards (cy) of 1½"-minus gravel and 250 cy of fish mix (coarse sand and pea gravel) were placed between +6' and mean higher high water. An additional 250 cy of coarse sand was placed at about +16' adjacent to the existing seawall. The gravel and coarse sand was placed on 500 linear feet of beach, and the fish mix placed on about 300 linear feet of beach immediately south of the new gravel.

Figure 1. Delivery of sand and gravel and initial spreading

2. Turbidity measurements were taken at least once every day during construction. Turbidity was measured at the surface by a Hach® portable turbidity meter kit. The turbidity measurements were taken 4 times at each location and then averaged. Measurements were taken 150 feet from the construction limits, with the majority of measurements taken along the shoreline. Baseline turbidity levels were measured on October 8 (when the Fauntleroy Ferry terminal was closed for construction)

and 14 (the first day of ferry terminal operation after construction), 2002. The turbidity measurements from October 8, 2002, are included for reference only. The baseline readings from October 14, 2002 were used for comparison purposes since the ferry operations may increase turbidity in the area and these readings are likely more indicative of baseline conditions when the construction occurred. The turbidity standard in the water quality certification was no more than 5 NTUs over background levels.

3. The water appeared to be very clear visually throughout the construction although, when the rising tide came into contact with newly placed material, a distinct turbidity plume was observed within the mixing zone (Figure 2). Of all the material, the most pronounced turbidity plume was associated with the fish mix that was required by a condition of the Hydraulic Project Approval. Visible turbidity appeared to settle prior to reaching the edge of the 150-foot mixing zone. Weather conditions during construction were extremely calm, which likely allowed the turbidity to settle more than if stormier weather had prevailed.

Figure 2. Incoming tide hitting stockpiles (note turbidity plume adjacent to stockpiles)

4. In general, the turbidity levels at the site were extremely low (Table 1) with individual turbidity measurements ranging from 0.2 to 9 NTUs. During construction, turbidity measurements were typically higher than the baseline readings and, in all but one case, remained within 5 NTUs of the baseline turbidity measurements.

5. On October 22 with an incoming tide, average turbidity measurement at one site was 7.68 NTU, 5.17 NTU higher than the average baseline turbidity. The subject October 22 measurement occurred 150 feet downcurrent from the end of the fish mix area. The standard deviation of this average turbidity measurement was 0.91 NTU and the standard deviation of the average baseline turbidity was 0.98 NTU. Since the standard deviation of both the baseline and the October 22 readings were much larger than the amount by which the October 22 reading exceeded 5 NTU over baseline, the average reading was considered to be consistent with the standard of 5 NTU over baseline.

TABLE 1. Turbidity Measurements

DATE	**Sample Location**	**Turbidity (NTU)**	
October 8	Along shoreline, 150' south of project limit	1.01	
	250' offshore from seawall	0.30	
October 14 (baseline)	Along shoreline, 150' north of project limit	3.11	**BASELINE AVERAGE:** 2.51
	Along shoreline, 150' south of project limit	1.90	
October 17 (construction)	150' offshore of project limit	0.51	
	Along shoreline, 150' south of project limit	3.93	
October 21 (construction)	Along shoreline, 150' north of project limit	4.15	
October 22 (construction)	Along shoreline, 150' south of project limit	5.00	
	Along shoreline, 150' north of project limit	3.18	
October 23 (construction)	Along shoreline, 150' north of project limit (a.m.)	3.13	
	Along shoreline, 150' south of project limit (a.m.)	3.14	
	Along shoreline, 150' north of project limit (p.m.)	1.62	
	Along shoreline, 150' south of project limit (p.m.)	***7.68*** *(5.17 over background)*	
October 24 (construction)	Along shoreline, 150' north of project limit	4.12	
	Along shoreline, 150' south of project limit	3.48	